T.E.

67½

RUSTLESS IRON.

The Bower-Barff

Rustless Iron Co.

OFFICES, No. 35 BROADWAY, NEW YORK.

FRANKLIN
INSTITUTE
LIBRARY

THE

BOWER-BARFF

RUSTLESS IRON COMPANY.

OFFICES:

No. 35 BROADWAY, NEW YORK.

1885.

THE

BOWER-BARFF RUSTLESS IRON COMPANY.

CAPITAL, - - - $750,000.

Directors.

GEO. W. MAYNARD, Mining Engineer.

ROSSITER W. RAYMOND, Ph. D.

CHAS. C. DODGE, late of PHELPS, DODGE & CO.

S. V. WHITE.

NIELS POULSON, of the Hecla Bronze and Iron Works.

JOHN BOWER, of Rochester, N. Y.

Officers.

GEO. W. MAYNARD, - - - - - - - *President.*

S. V. WHITE, - - - - - - - - *Treasurer.*

W. B. KUNHARDT, E. M., - - - - - - *Secretary and Engineer.*

R. W. RAYMOND, Ph. D., - - - - - *Consulting Engineer.*

THE BOWER-BARFF

RUSTLESS IRON PROCESSES.

THESE processes have for their object the absolute protection of iron and steel from rusting. This result is attained by the conversion of the surface of the metal into magnetic oxide of iron. The oxide is well known in its natural state as magnetic iron ore, which has withstood without deterioration or change centuries of exposure to the atmosphere and to fresh and salt water.

The BARFF process consists essentially in subjecting to the action of superheated steam the articles which are to be rendered rust-proof. The treatment is carried out in a specially constructed furnace, and is more particularly applicable to wrought iron and highly finished and polished work.

The BOWER process accomplishes the formation of magnetic oxide upon iron articles by subjecting them successively to the actions of highly heated air and carbonic oxide gas derived from coal fires. The hot air converts the metallic surface into red oxide of iron which is reduced to the black, or magnetic, oxide by the gas.

No foreign material, such as paint, alloy, or chemical of any kind, is applied to the metal, so that the coating is perfectly inocuous, and owing to the simplicity of the process, its cost is less than that of galvanizing.

Surfaces of iron and steel treated by the BOWER-BARFF processes present a pleasing blue-gray or blue-black color, and preserve the sharp outline of artistic and well-executed designs, while, if the articles are polished before treatment, the result of the oxidation is a lustrous, ebony-black finish, which is highly prized for its beautiful effect.

The value of the process has been thoroughly and satisfactorily demonstrated in this country for more than two years at the Hecla Bronze and Iron Works, in Brooklyn, N. Y., as is shown by the following letter :

HECLA BRONZE AND IRON WORKS,
POULSON & EGER,
North Eleventh and Third Sts.,
Brooklyn, N. Y.

APRIL 1, 1885.

THE BOWER-BARFF RUSTLESS IRON CO.,
35 Broadway, New York City :

DEAR SIRS—With reference to our furnace, we are glad to say that it has now been running some two and a half years steadily, with one shutting down of a week's time for cleaning. The working of the furnace has been uniform and satisfactory, while the results have been of such a character that, for certain classes of our work, we could not well do without the process. It has become an important factor in our business.

We have been particularly successful in the application of the process to a very large amount of ornamental wrought and cast iron work in the majority of the prominent buildings erected in New York City during the past two years. The process has met with great favor among architects, and promises a wide field in this direction.

From our experience, there is not a more effective or cheaper mode of protecting iron where the process has practical application.

Very respectfully,

POULSON & EGER.

Some of the finest architectural iron work in New York City is from the shops of Messrs. POULSON & EGER. Among conspicuous examples of work constructed by them is the East River Bridge Station in Brooklyn, the stair-work of which has been treated by the rustless process. They have also treated the great stairways and of other interior iron work of the new *N. Y. Produce Exchange*, and of many other important buildings, and are now applying the process extensively in the manufacture of fine mantels, grates, and other decorative work. A visit to the warerooms of the firm, No. 216 West Twenty-third Street, N. Y., will reveal to those interested in the process its varied adaptability and the beautiful effects obtained by it.

A number of leading architects have adopted the Oxide Process, not only on account of the rust-proof qualities imparted to the iron, but also because of the highly artistic finish given to their designs. Among the prominent buildings in which the iron-work has been in whole or in part treated by the process, or in which the treatment is required in the architect's specifications, are the following :

PRODUCE EXCHANGE.....NEW YORK CITY.
STANDARD OIL BUILDING..... " "
COTTON EXCHANGE..... " "
THE WESTERN UNION BUILDINGS IN BROAD STREET AND TWENTY-THIRD STREET.. ... " "
PARK BANK..... " "
BROOKS BUILDING..... " "
NAVARRO APARTMENT HOUSES..... " "
DAKOTA APARTMENT HOUSES..... " "
COLUMBIA COLLEGE LIBRARY BUILDING..... " "
MORTIMER BUILDING..... " "
BROOKLYN TERMINUS OF THE EAST RIVER BRIDGE. BROOKLYN, N. Y.
STEWART CATHEDRAL.....GARDEN CITY, L. I.
BANK OF THE REPUBLIC.....PHILADELPHIA, PA.
NEW HOME INSURANCE BUILDING .....CHICAGO, ILL.
NEW COURT-HOUSE .....CINCINNATI, O.
PRIVATE STABLES OF MR. BUSCH.....ST. LOUIS, MO.

The application of the process to finely finished machine fittings and gun work is attested in the following letter from one of the Company's licensees:

THE PRATT & CADY CO.,

HARTFORD, CONN., April 1, 1885.

THE BOWER-BARFF RUSTLESS IRON, NEW YORK:

GENTLEMEN—We have used the BARFF Process on finished iron with entire success, and we have thoroughly satisfied ourselves as to its excellence for our purposes. In our asbestos plug cocks we consider that it is the only process that could answer our requirements, and we find that the Barffed goods are very favorably received in the market.

We have done a little work for the PRATT & WHITNEY CO. on parts of guns, which give promise of very great usefulness. These parts, including barrels, were not changed in gauge or form in the least, and assembled as readily as before they were Barffed.

We should think the process could be used on all gun work to very great advantage.

Yours truly,

THE PRATT & CADY CO.

THE PRATT & CADY CO. manufacture steam fittings, water valves, cocks and high class work, where accuracy of gauge and rust-proof qualities are essential. They are now constructing a new furnace with four times the capacity of the one heretofore employed, in order to meet the constantly increasing demand for barffed work.

THE PRATT AND WHITNEY CO. have submitted gun work treated for them to the sal ammoniac rusting test of the U. S. Ordnance Department, and have found that the treated articles were absolutely unaffected.

The Oxide Process is applicable to all forms of cast, malleable and wrought iron and steel, where the surfaces are not subjected to very severe friction, nor injured by subsequent manipulation. It will supplant the expensive and usually unsatisfactory galvanizing, and for ordinary culinary utensils will take the place of tinning and enameling. Where for the sake of appearance enamel is preferred, English manufacturers have adopted the Process, because it is found that by first oxidizing the articles the enamel is rendered far more durable.

"Bowerized" iron can be plated with nickel and copper, and by rendering such *electro-plating proof against rust*, the Process greatly enhances the value of this mode of finish.

Seventeen furnaces have been erected in England, France and Germany for working the Oxide Process. The opinions of foreign licensees may be learned by reference to the letters at the end of this pamphlet.

In the United States four furnaces are now in operation and three more are in process of erection.

In evidence of the world-wide recognition of its excellence, the following medals have been awarded for iron treated by the BOWER-BARFF Processes:

SPECIAL GOLD MEDAL, CINCINNATI INDUSTRIAL EXPOSITION, 1884.

GOLD MEDAL, MELBOURNE EXHIBITION, 1881.

TWO SILVER MEDALS, INTERNATIONAL EXPOSITION, PARIS, 1878.

SPECIAL SILVER MEDAL, AMERICAN INSTITUTE, NEW YORK, 1883.

SILVER MEDAL, INTERNATIONAL HEALTH EXHIBITION, LONDON, 1884.

SILVER MEDAL, INTERNATIONAL UNIVERSAL EXHIBITION, LONDON, 1884.

SILVER MEDAL, SOCIETY OF ART, LONDON, 1876.

BRONZE MEDAL, SYDNEY, 1880.

BRONZE MEDAL YORKSHIRE INDUSTRIAL EXHIBITION, 1879.

BRONZE MEDAL ROYAL CORNWALL POLYTECHNIC SOCIETY, 1879.

SILVER AND BRONZE MEDALS, INTERNATIONAL EXHIBITION, LONDON, 1884, FOR ENAMEL WORK ON OXYDIZED IRON.

BRONZE MEDAL, AMERICAN INSTITUTE, NEW YORK, 1884, FOR "RUSTLESS" HOLLOW-WARE MANUFACTURED BY W. T. WELLS, NEW YORK, ONE OF THE COMPANY'S LICENSEES.

PROSPECTUS.

THE BOWER-BARFF RUSTLESS IRON COMPANY is the sole owner of the patents of Messrs. BOWER and BARFF, in America. The Company receives applications for licenses to use its Processes, disposes of territorial rights and furnishes working drawings and estimates for the erection of special furnaces in which the treatment is carried out.

The fullest facilities are afforded for testing and studying the BOWER-BARFF treatment, and detailed information is gladly tendered to parties desiring to become acquainted with the working of the Processes. Parties erecting furnaces are fully instructed in their management by the Company's engineers.

Samples of "*rustless*" cast and wrought iron are on exhibition at the company's offices, and will be sent on application. In particular cases arrangements are made to treat special iron work as a sample, and work so sent to the Company after due correspondence, must invariably have express and freight charges *prepaid*.

NOTES ON THE BOWER-BARFF PROCESSES.

The following brief review of the processes, in their leading features and most recent developments, may serve to show how readily they can be adapted through a very extended range of iron manufacturers.

Mode of Treatment.—The conversion of the surface of metallic iron into magnetic oxide of iron is carried out in a furnace. The articles to be treated, whether large or small, are loaded upon an iron drag and shoved into a fire-brick chamber, known as the oxydizing chamber of the furnace. Gas producers, which constitute a part of the furnace structure, generate carbonic oxide gas from a thick bed of coal upon the producer grates; this gas is burned by an admixture of air in a combustion flue beneath the oxydizing chamber, and either the burning gases, or the hot products of combustion, according as the gas and air valves are regulated, enter through ports into the chamber, heating the charge and then passing through exit ports to the chimney. After the goods have been raised by this means to the desired temperature, which may vary from an incipient red to a cherry heat, depending on the nature of the work, the treatment of the charge—should this consist of castings—by the BOWER process of oxydizing and reducing operations is begun. During the period of oxidation the connection with the gas producers is almost entirely cut off by a damper, and air raised to a high temperature by passing through the hot combustion flue above mentioned, enters the chamber and oxydizes the iron, converting its surface into the red oxide of iron ($Fe_2 O_3$). After about forty minutes of this treatment the admission of air to the furnace is stopped and the producer gases are allowed to pass for twenty minutes through the chamber without any admixture whatever. The chemical action of these gases upon the ironware results in a change, or reduction, of the superficial coating of red oxide of iron into the black, or magnetic oxide ($Fe_3 O_4$). The operations are repeated a number of times, so that the whole treatment lasts from ten to twenty hours, according to the thickness of the coating to be produced. At the end of the treatment the charge is withdrawn and the furnace is then ready for treating another lot of ware.

The BARFF process for wrought iron is carried out in the same furnace designed for the BOWER treatment. The articles are charged and heated in the same manner as above, and when the proper temperature is reached, highly superheated steam is introduced into the oxydizing chamber where a slight plenum, not exceeding one to two inches of water pressure, is maintained for a period of ten to twenty hours. The steam from a half-inch pipe more than suffices for all the requirements. The superheating is easily effected by a continuous coil-pipe superheater, or by a couple of small intermittent superheating chambers, each filled with a loose checker-work of fire-brick, and forming part of the furnace structure.

The BOWER, or air, process is the more economical one for the treatment of ordinary cast iron, whereas, for wrought and malleable iron the BARFF, or steam, process has been found more advantageous. Where wrought and cast iron work are combined, the BARFF process is applicable; the steam treatment of the cast iron in such a case merely necessitates a longer period of exposure in the furnace than would suffice for producing the desired coating by the air process.

The mechanical finish of the iron, be this either wrought or cast, determines, to a large extent, the mode of treatment. Rough articles, from which the skin has not been removed, require for the formation of a proper coating in a given time higher heat

and more energetic oxydation than goods whose surfaces are more or less finished. A high heat on a finished surface tends to blister and detach the magnetic oxide as it is formed. When articles, therefore, present some finished surfaces and others which are rough, a comparatively low heat is used in the oxydizing chamber, thereby precluding the possibility of injuring the surface, while the treatment is continued for a sufficient length of time to ensure the thorough oxydation of the rough parts, even at the reduced temperature.

For the steam treatment of highly polished articles, a small muffle furnace is employed. The charge is heated by a flame which plays externally around the muffle ; the increased expenditure of fuel thus incurred in heating the articles is more than compensated, in a furnace of small size, by the ease with which even a slight over-heating of any portion of the polished goods is prevented.

The Furnace.—The accompanying plate of illustrations shows the exterior views of a furnace having an oxydizing chamber that is sixteen feet long, five and one-half feet wide, and four and one-half feet high. The furnace is designed for treatment, both by the BOWER and the BARFF processes. The counterweighted door, shown in the front elevation, is raised and lowered in front of the chamber ; the position of the two gas producers is indicated by the coal-charging hoppers upon them ; the main chimney-stack is seen at the rear of the furnace, and the two smaller stacks are set immediately above two steam superheating chambers, which are heated by gases from the producers. In order to heat a charge as uniformly as possible in a furnace of this size, the arrangement is such that the direction of the flame, or of the heating gases, can be periodically reversed ; at one time they enter the oxydizing chamber through ports in the floor along the right wall and pass out along the left, while at another time, by a movement of the dampers, the draught is changed so as to course through the chamber in the opposite direction.

Furnaces vary in size from those having an oxydizing chamber of only two or three feet cubic capacity to such as have a chamber fifteen to twenty feet long, and other dimensions proportional. The cost of the furnace ranges from $250 to $3,500, or even more, according to size. The capacity of a furnace in terms of the articles treated depends on the bulkiness of the latter rather than upon their weight ; the oxydizing chamber can be nearly filled with goods, and these, of course, may be either heavy or light. The cost of treatment, including royalty, in no case exceeds, and is generally much below, that of galvanizing.

Preparation of the Iron.—Certain points in the preparation of the iron for treatment are observed to insure satisfactory results.

(1) Foundry sand, if left on castings, generally bakes to a reddish-brown color in the furnace, producing unsightly, rust-like spots. Where the appearance of the article is of no consequence, this is not in itself an objection, since the rust-proof qualities are not impaired by the sand, but wherever the coating is to serve as a mode of finish, and no painting is intended, the foundry sand must be removed by pickling and cleansing with a steel brush, preparatory to treatment. Care must be observed to thoroughly remove all excess of pickle by washing in hot water after withdrawing the articles from the pickling vat. A dilute sulphuric or hydrochloric acid solution (3—5 % acid) makes a good pickle, in which the castings are immersed only just long enough to loosen the adhering sand—or about ten to twenty minutes. Over-pickling is in every way objectionable.

(2) In treating wrought iron a handsome appearance of the oxydized ware is only obtained by removing all forge or rolling-mill scale before treatment. Pickling and

brushing accomplish this, but for a large class of ordinary ware the expense of this preparation is not incurred, and only the loose scale is brushed off the articles before treatment.

(3.) Articles which are to have a bright polished surface, must be polished to the full extent desired *before* treatment in the furnace.

(4.) Blow-holes or other defects in castings must not be plugged with lead, for the action of lead in the furnace is decidedly injurious to the iron. Only brass or iron plugs can be used.

(5.) The iron generally undergoes a very slight permanent expansion in the furnace, but this is not sufficient to require any special fitting or loose threading of screws, except in cases of very tight, accurate fit. In columns and stair stringers for architectural work, in which slight errors multiply by repetition, a scant measurement of $\frac{1}{32}$ inch per foot has been found to allow sufficiently for permanent expansion.

(6.) All drilling of holes, trueing of faces, etc., must be done *before* treatment, to save the magnetic oxide coating from the injury which subsequent fitting would cause.

Properties of "Rustless Iron."—The magnetic oxide coating is very hard, but comparatively inelastic. It withstands the wear due to friction, but is injured by blows of the hammer and rough usage. Wherever from this cause the coating is chipped the iron rusts, though the rust remains localized; it does not spread or raise the coating as is the case with paint or electro-deposits.

The protection of the iron being due to a *superficial* layer of magnetic oxide, and not to anything penetrating the metal (which would weaken it), it follows that any manipulation that would injure or destroy the continuity of the surface of the iron, must necessarily prove destructive of the coating. In riveting, for example, the coating in the immediate neighborhood of the rivet-holes suffers; similarly, in driving nails through sheet iron roofing, the oxide is chipped at the holes; in fitting "rustless" gas and steam pipe it is injured by the bite of the wrench and vise unless these are furnished with lead or copper cheeks; in shearing, it scales along the edge of the metal, and in flanging or bending sheet iron the coating on the line of the bend is cracked. The limit of elasticity of the oxide is practically the same as that of the iron; it adheres firmly to the metal under tensile and compressive strains until this limit has been reached, and no further.

A piece of "rustless" iron can be heated to redness and then plunged into cold water without the least scaling or other change, while coverings of paint, tin, galvanizing and enamel suffer very much under such action. For this reason "rustless" hollow-ware is more readily cleaned than even enamel ware; the latter must be allowed to cool after use; and the remains of food in it become dried and congealed, and stick to the utensil, necessitating considerable scraping and involving danger of injuring the enamel.

Magnetic oxide withstands the action of many brines, alkalies, sulphureted gases and weak, organic acids, but it is gradually dissolved by sulphuric and hydrochloric and other powerful acids. The corroding action of these acids, however, is considerably retarded on "rustless" iron, and hence such iron has been successfully used in chemical works where it was exposed to strong acid fumes.

Coated articles have been exposed for years without the slightest deterioration to sea-water and to the most varied atmospheric conditions. Cast iron urinals, used for ten months in the yard of an iron works, have remained perfectly free from corrosion.

MECHANICAL TESTS WITH "RUSTLESS IRON."

The following tests show conclusively that iron is not weakened by the BOWER-BARFF treatment: the action in the oxydizing furnace is incidentally one of annealing and this compensates, and in many cases of thin casting more than compensates, for the very thin layer of metal which is oxydized and loses its strength in the treatment.

REPORT OF TESTS BY SIR JOSEPH WHITWORTH OF LONDON:

METAL NO. 433.

BEFORE TREATMENT.		AFTER TREATMENT.	
PRESSURE IN TONS.	ALTERATION.	PRESSURE IN TONS.	ALTERATION.
15	Nil.		
17	"		
18	"		
19	"	18	Nil.
20	"	19	"
21	"	20	"
22	.0002	21	.0008
23	.0008	22	.0022

METAL NO. 603.

BEFORE TREATMENT.		AFTER TREATMENT.	
PRESSURE IN TONS.	ALTERATION.	PRESSURE IN TONS.	ALTERATION.
15	Nil.		
17	"		
18	"		
19	"	18	Nil.
20	"	19	"
21	.0002	20	"
22	.0009	21	.0007
		12	.0023

REPORT OF TESTS BY PROFESSOR BACH OF THE STUTTGART POLYTECHNIC INSTITUTE.

These tests were made on forty-eight 19.9 millimeter ($\frac{4}{5}$ inch) round bars, the tabulated results being averages of six tests each :

Wrought-Iron.

	Tensile strength.		Elongation, p. c. p. 100 mm.	p. 200 mm.	Contraction of area, p. c.
Not treated	lbs. p. sq. in....	64,960	20.7	17.5	27.2
	k. p. sq. cm....	3,567			
Treated 3 hours	lbs. p. sq. in....	48,362	21.8	18.6	29.6
	k. p. sq. cm....	3,400			
" 5 "	lbs. p. sq. in....	49,756	21.2	19.6	31.2
	k. p. sq. cm....	3,498			
" 5 "	lbs. p. sq. in....	49,557	21.8	19.0	31.8
	k. p. sq. cm....	3,485			

Cast-Iron.

		Tensile strength.
Not treated	lbs. p. sq. in	28,022
	k. p. sq. cm	1,970
Treated 4 hours	lbs. p. sq. in	26,826
	k. p. sq. cm	1,886
Treated 6 hours	lbs. p. sq. in	27,524
	k. p. sq. cm	1,935
Treated 6 hours	lbs. p. sq. in	28,050
	k. p. sq. cm	1,872

According to these figures, the effect of the treatment of iron by the BOWER-BARFF process is in the main limited to the action of annealing. So far as the effect of strains upon the coating of magnetic oxide is concerned, it was noted that small particles scaled off from wrought-iron when the tensile strength reached 2012 kilograms, or 28,618 pounds per square inch, and that in the case of cast-iron it did not come off, even when strained to the point of rupture.

EXTRACTS FROM LETTERS.

From a large number of foreign testimonials a few are selected to show the successful adaptation of "rustless iron" to special purposes. These, together with the American letters in the first pages of this pamphlet, speak for themselves :

FROM MESSRS. SMITH & WELLSTOOD, AMERICAN STOVE MANUFACTURERS, GLASGOW.

We take great pleasure in telling you that, in our judgment, your process for oxidizing the surfaces of iron manufactures is a complete practical success in preventing the slightest appearance of rust. We have had in use and under test in every way we could think of, for the last six months, one of our portable cast-iron farm and laundry boilers (a 22-gallon size), coated by your oxidizing process, and not a sign of the least rust or the slightest discoloration of pure, clean water has at any time shown itself, although the said boiler has several times been standing out of use for weeks, with portions of water in it to induce rusting. Another test we have given it,

and which satisfies us of its value, is by several times firing the boiler with only a small portion of water in it, thereby exposing all above the water line to a strong heat, and without any perceptible injury to the surface coating, and this is certainly what *neither the galvanizing nor the enameling process would stand.*

FROM MESSRS. JNO. HARDMAN & CO., ART METAL WORKERS, BIRMINGHAM.

We have used for over a period of two years the BARFF process, and have found it to fulfil all our requirements. We have had bell-pulls, hinges, etc., exposed to all kinds of weather, and they stand without any apparent change.

FROM THE ENGINEERS OF THE FOLLOWING GAS COMPANIES.

THE HORNSEY GAS COMPANY.—I have had your tubes for twelve months in an atmosphere most trying to iron work, and they are not affected.

THE CRYSTAL PALACE GAS COMPANY.—I have had some of your tubes laid for upwards of twelve months in ashes, exposed to air and moisture, and except where the coating has been disturbed by violence the tubes do not show the slightest signs of corrosion. It is well known that such ashes have a most destructive effect upon ordinary tubes.

THE NICTHEROY GAS COMPANY.—I have uncovered a service laid with tubes coated by BARFF'S process, which was laid over eighteen months ago, and it is free from rust and as clean as when first laid.

THE CITY OF CARLISLE GAS WORKS.—The pieces of pipe were placed in a humid atmosphere for twelve months, and I find they present no change in appearance whatever.

FROM T. MAXWELL WITHAM, ESQ.

5 GRAY'S INN SQUARE, LONDON.

The portions of roller skates treated by your process have given great satisfaction. Before being so treated it occupied one man to keep them free from rust, as the skates are at Ostend, and the rink close to the sea; but since they have been treated they are quite free from rust. The skate fittings you treated for me personally have also given great satisfaction, but these have not been submitted to the action of the sea air like those at Ostend.